PATENT SPECIFICATION

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COMPLETE SPECIFICATION

"Improvements in and relating to gypsum products."

We, GYPROC PRODUCTS LIMITED, a British Company, of "Westfield," Upper Singlewell Road, Gravesend, Kent, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in and relating to gypsum products, such as wallboard, composed of calcined and set gypsum, and in particular relates to such gypsum products having a cellular structure, and to a method of making such gypsum products.

In the manufacture of gypsum wall boards as normally carried out hitherto, calcium sulphate hemihydrate, commonly known as Plaster of Paris, which is itself the result of the dehydration of the natural raw material gypsum rock, is rehydrated to its original gypsum state by adding excess water to it and reducing it to a homogeneous slurry mixture by violent agitation in an appropriate mixing apparatus or machine. The slurry mixture from this machine is fed continuously between continuously unrolling strong top and bottom paper sheets passing between two revolving spaced parallel rollers the spacing of which is adjustable and determines the thickness of the paper covered core, which is usually $\frac{1}{4}$" or $\frac{3}{8}$" or $\frac{1}{2}$" or more. Thus, a long continuous band is formed which, when setting or hardening of the slurry, now constituting the core, has taken place, is cut to the desired lengths required for the gypsum boards. The cut lengths are thereafter passed through a drying kiln at regulated speed for about one and a half hours and at a temperature of about 250°F. to free them from the excess of slurry water.

When, however, the core of such boards is composed exclusively of neat gypsum, the boards are of great weight for unit volume, the weight per unit volume being the same irrespective of the board's thickness, and this constitutes a drawback particularly from the point of view of transport. As a typical example, 1,000 square feet of gypsum boards of $\frac{3}{8}$" thickness in which the core is formed of neat gypsum may weigh 1,875 lbs.

Many endeavours have been made to overcome this drawback by reducing the weight of the boards whilst maintaining the volume. For instance, wood chips and/or sawdust have been introduced into the gypsum slurry. Again, a mechanically prefoamed composition comprising a saponified rosin and expensive casein as a stabilising agent, necessitating special and costly machinery has been made use of. Various chemical processes directed to the generation of gas bubbles to form a core of cellular structure have also been proposed.

Another drawback encountered in the production of gypsum boards by the normal method described above, is that the gypsum core does not always form the desirable firm bond with the covering top and bottom paper liners, and to overcome this drawback an expensive additive has been used comprising soluble boiled starch which is mixed with the dry Plaster of Paris, the two components being then slurried together.

It is a first object of this invention to produce gypsum products composed of calcined and set gypsum and having a cellular structure.

A subsidiary object is to produce gypsum wallboards having a lightweight core composed of calcined and set gypsum, possessing a high inherent bonding power to bond the top and bottom paper sheets to the core, whereby the need for the use of hitherto used starch is eliminated.

According to this invention there are provided gypsum products, such as wallboards, composed of calcined and set gypsum having a cellular structure, the cellular gypsum material of which said articles are formed comprising gypsum, a saponified rosinate, and a resinous condensation product of formalde-

hyde with one or more of the group consisting of the xylenols, phenol and the cresols.

Also according to this invention, a method of making gypsum products, such as wallboards, composed of calcined and set gypsum having a cellular structure, includes the steps of blending a slurry formed from calcium sulphate hemihydrate and water with a saponified rosinate and a liquid resinous condensation product of formaldehyde with one or more of the group consisting of the xylenols, phenol and the cresols, the said resinous condensation product being in the first stage as specified herein, agitating the blend to produce a stable foamed-up mass, and drying the foamed-up mass.

Preferably, the said liquid resinous condensation product is of formaldehyde with m-cresol, or a mixture of m-cresol and p-cresol and such a product will herein be called a "cresol formaldehyde resin."

It is well known that the manufacture of such formaldehyde resinous condensation products may proceed in three stages according to the temperature and duration of the process. A first stage results in a liquid, water-soluble condensation product. A second stage results in a heavy condensation syrup which is insoluble in water but soluble in alcohol. A third and final stage results in a condensation product which is an insoluble solid.

We prefer to make use of the liquid product of the first stage which may contain from 40% to 80% by weight of resin solids, and to blend this with a saponified resinate. When such a blend is diluted with water and subjected to violent agitation for 1 minute at atmospheric pressure and at 70°F. a considerable increase over its original volume takes place. For example a blend of 0.95 gr. of a liquid cresol formaldehyde condensate containing 46% resin solids and 0.95 gr. of saponified colophony diluted with 264 c.c's water, the mixture having a total volume of 270 c.c's, increased in volume to 850 c.c's, taking the form of a stable foamed-up mass. In such a foamed-up mass the cresol formaldehyde resin fulfils the role of stabilizer to the foamed-up saponified rosin.

This example, however, is based on averages of small scale laboratory research tests and it is to be understood that under the conditions of continuous large scale manufacture, these figures do not necessarily apply and they are to be regarded as a guide only, particularly in that it is necessary in practice, in the manufacture of wallboards, to reconcile the achievement of low density of the core with a strong bond between the core and the paper liners.

As an example of larger scale practical test, a "foaming-up" solution was prepared consisting of a blend of 82 lbs of a cresol-formaldehyde resin solution containing 46% resin solids with 176 lbs. of saponified rosin and 170 gallons of water. This solution was run continuously for eight hours simultaneously with a slurry comprising 106,000 lbs. of Plaster of Paris (calcium sulphate hemihydrate) and 7,930 gallons of water into a mixing machine in which the whole whilst passing through, was subjected to violent agitation so that emulsification took place and the material on its emergence presented a cellular structure.

The mass upon issuing from the machine was fed continuously between the usual strong paper sheets or liners and the paper coated strip or sheet cut into lengths which were then moved continuously through a drying oven in the manner employed for known plaster boards.

The combined quantity of materials quoted above correspond to a superficial area of 80,000 square feet of $\frac{3}{8}$" of dry boards. 1,000 square feet of $\frac{3}{8}$" gypsum boards produced as described above, picked at random, were found to have a lightweight core and, owing to its cellular structure, the boards weighed 1,500 lbs. as compared with 1,875 lbs. for 1,000 square feet of $\frac{3}{8}$" boards produced by the hitherto normal method. By increasing the proportion of foaming-up solution to Plaster of Paris in the blend the density of the boards can be still further reduced.

Furthermore, the bonding of the paper liners to the gypsum core was found to be uniformly satisfactory and as good as the best bond achieved between the gypsum core and paper liners of the known gypsum wallboards in which starch, as referred to above, was made use of. It would appear that the combination of a resinous condensation product with a saponified rosinate when emulsified as described above results in a stable foam possessing a definite tacky adhesive character, and as final condensation of the resinous condensation product takes place under the heat of the drying process it functions as a cementing medium.

The Plaster of Paris employed in the test is derived by calcination from a gypsum showing upon analysis to contain from 90 to 95% calcium sulphate dihydrate.

The ratio of resinous condensation product to saponified rosinate may be varied widely according as greater stabilization of the foam and strength of core or greater volume of the foam itself is required. For example if great stabilization of the foam is required the ratio may be as much as 5 or more by weight of the former to 1 of the latter, but if more foam volume is required this ratio may be reversed or may lie between these limits.

What we claim is:—

1. Gypsum products composed of calcined and set gypsum having a cellular structure, the cellular gypsum material of which said articles are formed comprising gypsum, a saponified rosinate, and a resinous condensation product of formaldehyde with one or more

of the group consisting of the xylenols, phenol and the cresols.

2. Gypsum products as claimed in Claim 1, wherein the said resinous condensation product is of formaldehyde with m-cresol, or a mixture of m-cresol and p-cresol.

3. Gypsum products as claimed in Claim 1 or 2, wherein the ratio by weight of saponified rosin to resinous condensation product is five to one, or one to five, or lies between these two values.

4. Method of making gypsum products composed of calcined and set gypsum having a cellular structure, the method including the steps of blending a slurry formed from calcium sulphate hemihydrate and water with a saponified rosinate and a liquid resinous condensation product of formaldehyde with one or more of the group consisting of the xylenols, phenol and the cresols, the said resinous condensation product being in the first stage as specified herein, agitating the blend to produce a stable foamed-up mass, and drying the foamed-up mass.

5. Method as claimed in Claim 4, wherein the liquid resinous condensation product contains from 40% to 80% by weight of resin solids.

6. Method as claimed in Claim 4 or 5, wherein the said resinous condensation product is the reaction product of formaldehyde with m-cresol, or a mixture of m-cresol and p-cresol

7. Method as claimed in any one of Claims 4 to 6, wherein the ratio by weight in the blend of saponified rosinate to resinous condensation product is five to one, or one to five, or lies between these two values.

8. Wallboards composed of calcined and set gypsum having a cellular structure, substantially as hereinbefore described.

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PROVISIONAL SPECIFICATION

"Improvements in and relating to gypsum products."

We, GYPROC PRODUCTS LIMITED, a British Company, of "Westfield," Upper Singlewell Road, Gravesend, Kent, do hereby declare this invention to be described in the following statement: —

This invention relates to improvements in and relating to gypsum wall boards, and in particular to a method of producing cores for gypsum wall boards, having a cellular and lightweight structure.

In the manufacture of gypsum wall board as normally carried out hitherto, gypsum hemihydrate, commonly known as Plaster of Paris, which is itself the result of the dehydration of the natural raw material gypsum rock, is rehydrated to its original gypsum state by adding excess water to it and reducing it to a homogeneous slurry mixture by violent agitation in an appropriate mixing apparatus or machine. The slurry mixture from this machine is fed continuously between continuously unrolling strong top and bottom paper sheets passing between two revolving spaced parallel rollers the spacing of which is adjustable and determines the thickness of the paper covered core, which is usually $\frac{1}{4}$" or $\frac{3}{8}$" or $\frac{1}{2}$" or more, so that a long continuous band is formed which, when setting or hardening of the slurry, now constituting the core, has taken place, is cut to the desired lengths required for the final gypsum boards. The cut lengths are thereafter passed through a drying kiln at regulated speed for about one and a half hours and at a temperature of about 250°F. to free them from the excess of slurry water.

When however, the core of such boards is composed exclusively of neat gypsum, the boards are of great weight for unit volume, the weight per unit volume being the same irrespective of the board's thickness and this constitutes a drawback particularly from the point of view of transport. As a typical example, a 1,000 square feet of gypsum boards of $\frac{3}{8}$" thickness in which the core is formed of neat gypsum may weigh 1,875 lbs.

Many endeavours have been made to overcome this drawback by reducing the weight of the boards whilst maintaining the volume. For instance, wood chips and/or saw dust have been introduced into the gypsum slurry. Again, a mechanically pre-foamed composition comprising rosin soap and expensive casein as a stabilising agent, necessitating special and costly machinery has been made use of. Various chemical processes directed to the generation of gas bubbles to form a core of cellular structure have also been proposed.

Another drawback encountered in the production of gypsum boards by the normal method described above, is that the gypsum core does not always form the desirable firm bond with the covering top and bottom paper liners, and to overcome this drawback an expensive corrective has been used, consisting in the admixture of soluble boiled starch with the dry Plaster of Paris, and the two components being then slurried together.

It is a first object of this invention to produce a lightweight gypsum core for gypsum wall board.

A further object is to produce a lightweight gypsum core in gypsum wall board, possessing a high inherent bonding power to bond the top and bottom paper sheets to the gypsum core, whereby the need for the use of hitherto used starch is eliminated.

Other objects will become apparent from the following description.

The first object is attained by making use of a resinous condensation product of formaldehyde and a phenolic compound, which may be phenol; m-cresol or a mixture of m-cresol and p-cresol, hereinafter called "cresol formaldehyde resin" and also xylene as an additive to the gypsum plaster.

It is well known that the manufacture of such formaldehyde resinous condensation products may proceed in three stages according to the temperature and duration of the process. A first stage results in a fluid, water-soluble condensation product. A second stage results in a heavy condensation syrup which is insoluble in water but soluble in alcohol. A third and final stage results in a condensation product which is an insoluble solid.

We prefer to make use of the product of the first stage which may contain from 40% to 80% condensation matter, and to blend this with a saponified rosin. When such a blend is diluted with water and subjected to violent agitation for 1 minute at atmospheric pressure and at 70°F. a considerable increase over its original volume takes place. For example a blend of 0.95 gr. of cresol formaldehyde resin containing 46% soluble condensation matter and 0.95 gr. of saponified colophony diluted with 264 c.c's water, the mixture having a total volume of 270 c.c's, increased in volume to 850 c.c's, taking the form of a stable foamed-up mass. In such a foamed-up mass the cresol-formaldehyde resin fulfils the role of stabilizer to the foamed-up saponified resinate.

This example, however, is based on averages of small scale laboratory research tests and it is to be understood that under the conditions of continuous large scale manufacture, these figures do not necessarily apply and they are to be regarded as a guide only, particularly in that it is necessary in practice to reconcile the achievement of low density of the core with a strong bond between the core and the paper liners.

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Furthermore the bonding of the paper liners to the gypsum core was found to be uniformly satisfactory and as good as the best bond achieved between the gypsum core and paper liners of the known gypsum wallboards in which starch, as referred to above, was made use of. It would appear that the combination of cresol-formaldehyde resin with a saponified resinate when emulsified as described above results in a stable foam possessing a definite tacky adhesive characteristic, and as final condensation of the cresol-formaldehyde resin takes place under the heat of the drying process it functions as a cementing medium.

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